

PRELIMINARY DATA SUMMARY

September 1989

U.S. Army Engineer Waterways Experiment Station
Coastal Engineering Research Center
Field Research Facility
Duck, North Carolina

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CERC Field Research Facility
Duck, North Carolina

This report provides a summary of basic oceanographic, meteorological and bottom profile data for the month. The data were obtained as part of the Measurements and Analysis work units at the U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's Field Research Facility (FRF) in Duck, North Carolina. The FRF staff collected and analyzed these data. These summaries are intended to make the data readily available to all FRF users, and comments on their content and usefulness are invited.

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PART I: INTRODUCTION

The U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's (CERC's) Field Research Facility (FRF) is located on the Outer Banks of North Carolina, near the village of Duck (Figure 1).

The FRF research program provides a means for obtaining high-quality field data, particularly during storms, in support of the U.S. Army Corps of Engineers' coastal engineering research missions. The research pier is a reinforced concrete structure supported on 0.9-m-diam steel piles spaced 12.2 m apart along the pier's length and 4.6 m apart across the width. The pier deck is 6.1 m wide and extends from behind the duneline to about the 6-m water depth contour at a height of 7.6 m above the National Geodetic Vertical Datum (NGVD). In addition, a main building contains offices, an instrument repair shop, and a data acquisition room.

One of the responsibilities of the FRF research program is the collection, analysis and dissemination of data on local oceanographic and meteorological conditions. Bottom profiles along both sides of the pier and periodic bathymetric surveys are also performed.

This summary is intended to provide basic data as soon as possible after they are obtained. Questions and/or comments concerning the data may be directed to Mr. Michael W. Leffler at (919) 261-3511.

Part II presents the meteorological data; Parts III through VI present oceanographic data; Part VII presents nearshore profiles and bathymetry; and Part VIII, if included, documents special events that occurred at the FRF during the month.

Table 1 is a list of instruments used, their operational status during the month, and the data collection status. Figure 2 identifies the location of the instruments. The water depths at the wave gages and current meters vary and may be determined from information contained in Figure 7. Other installation information is contained in Table 1.

Times given in the report, unless otherwise specified, are referenced to eastern standard time (EST).

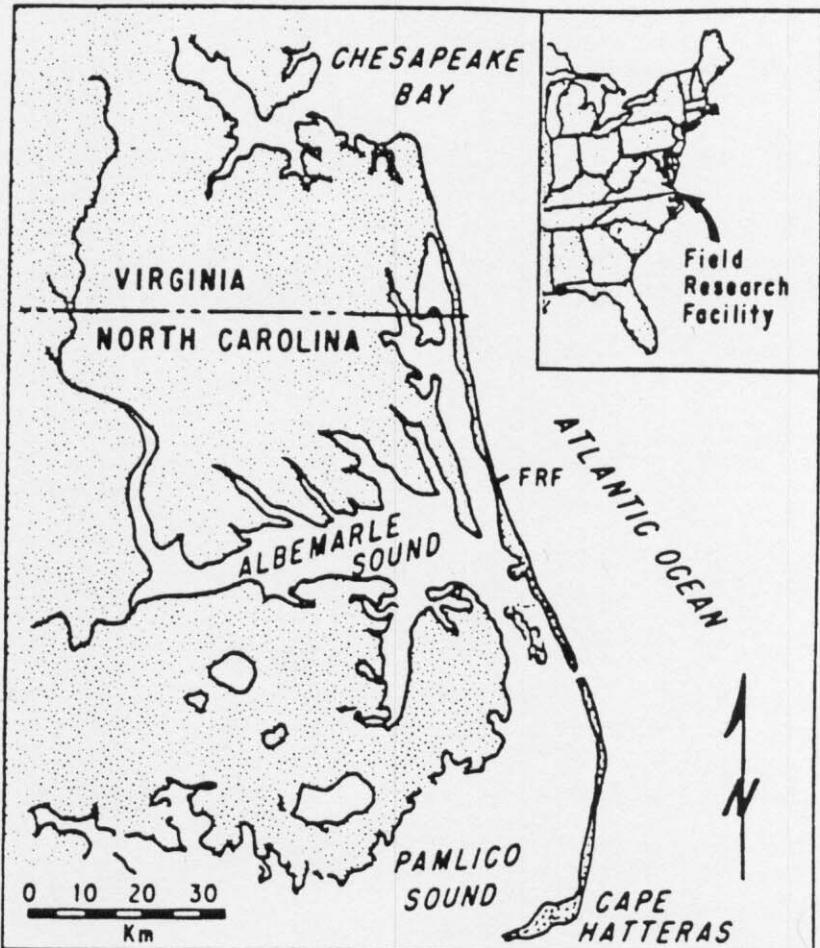


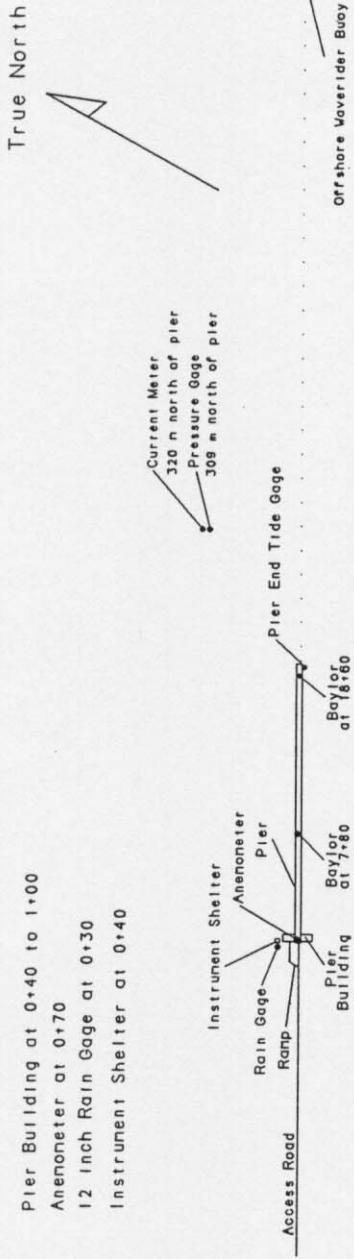
Figure 1. FRF location map

Table 1: Instrument Status/Data Availability

SEP 1989

Gage ID	Description/Remarks	Depth at Sensor		Day of the month																												
				1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
616	Barometric Pressure		Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
			Analog Record	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
604	Precipitation		Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
624	Air Temperature		Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*			
632	Anemometer on Laboratory Building Elevation 19 m (NGVD)		Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
			Analog Record	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
645	Baylor staff at station 7+80 on FRF pier	see Figure 7	Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	/ /		
625	Baylor staff at station 18+60 on FRF pier	see Figure 7	Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
111	Pressure gage 309 m north of FRF pier (0.9 km offshore)	Approx. 7.8 m NGVD	Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
630	Waverider buoy 6.0 km offshore	Approx. 23 m NGVD	Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	/ / /		
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
519	Current meter 320 m north of FRF pier (0.9 km offshore)	see Figure 7	Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*			
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*			
865-1370	NOAA tide station at seaward end of FRF pier		Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*			
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*			
	Supplemental Observations (daily oceanographic and meteorological observations)		Daily observation	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*			

Gage Status	Daily Observation	Analog Record	Data Collected
Operational = *	Complete = *	Complete = *	All = *
Partial = /	Partial = /	Partial = /	Partial = /
Non-Operational = -	None = -	None = -	None = -



CURR ITUCK SOUND

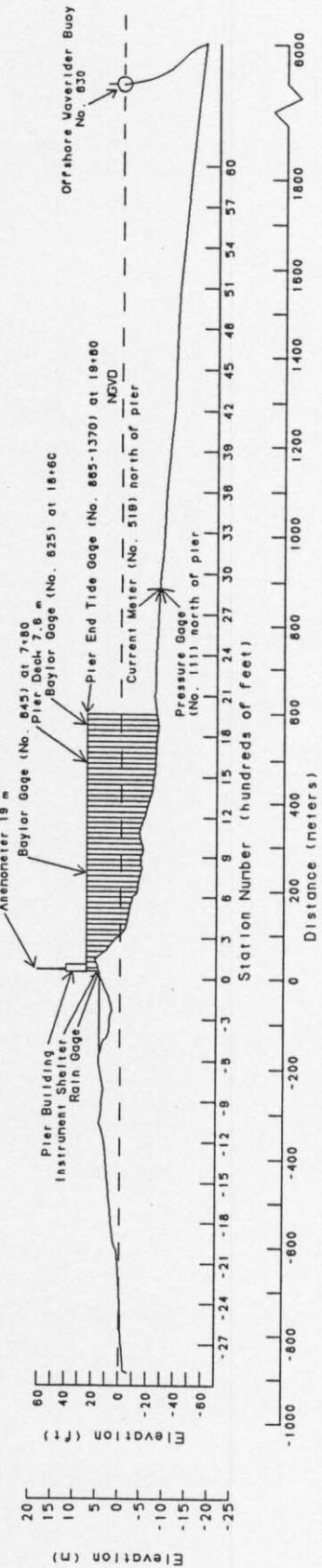


Figure 2. Instrument locations at FRF (all elevations from NGVD, all distances from FRF baseline).

PART II: METEOROLOGICAL DATA

A variety of instruments have been installed at the FRF (Figure 2) to monitor the meteorological conditions. The data presented in Table 2 are collected and stored on magnetic tape using a Digital Equipment Corporation VAX 11/750. For each instrument identified in Table 1 as having analog outputs, chart records are obtained, a log is maintained and the records are stored for future reference.

Winds were measured on top of the laboratory building at an elevation of 19 m (Figure 2) using a Weather Measure Skyvane anemometer.

Monthly resultant wind speeds and directions are determined by vector averaging the data. Temperature and atmospheric pressure means are the average of the values presented for the month. Total precipitation is the sum for the month.

The following may be useful for converting the data in Table 2 to other frequently used units of measurement:

1. Millimeters (mm) to inches (in.) -
 $mm \times .03937 = in.$
2. Millibars (mb) to inches of mercury (in. Hg) -
 $mb \times 0.02953 = in. Hg$
3. Degrees Celsius (C) to degrees Fahrenheit (F) -
 $(C \times 9/5) + 32 = F$
4. Meters per second (m/s) to knots (kn) -
 $m/s \times 1.943 = kn$

Table 2: Meteorological Data

Sep 1989						
Day	Hour	Wind	Wind	Temperature	Atm	Precipitation *
		Speed m/sec	Direction deg TN	deg C	Pressure mb	mm
1	100	5	100	23.5	1015.5	0
	700	2	146	25.7	1015.2	0
	1300	3	169	29.7	1013.5	0
	1900	5	176	26.5	1011.4	0
2	100	6	209	25.4	1011.4	0
	700	5	210	25.9	1011.4	0
	1300	6	23	26.7	1011.8	0
	1900	5	55	24.9	1013.1	0
3	100	8	45	24.8	1014.8	0
	700	11	40	24.0	1016.9	0
	1300	9	23	25.2	1018.6	0
	1900	13	38	23.2	1018.6	0
4	100	12	43	23.0	1019.2	0
	700	12	52	23.3	1020.6	0
	1300	12	54	24.5	1021.3	0
	1900	12	59	23.5	1020.9	0
5	100	11	62	23.8	1020.6	0
	700	10	55	23.8	1021.3	0
	1300	9	52	24.4	1021.3	0
	1900	10	39	23.7	1021.3	0
6	100	7	54	23.5	1020.3	0
	700	8	53	24.0	1020.3	0
	1300	8	38	24.2	1019.9	0
	1900	9	34	22.2	1019.2	0
7	100	10	38	22.1	1017.2	0
	700	9	22	22.8	1017.2	0
	1300	8	20	24.4	1016.5	0
	1900	7	42	22.8	1015.5	0
8	100	5	31	22.1	1014.8	0
	700	6	25	22.5	1015.5	0
	1300	5	16	24.0	1014.8	0
	1900	4	45	21.9	1013.8	0
9	100	1	53	21.4	1013.8	0
	700	1	344	22.6	1013.8	0
	1300	3	73	25.8	1013.5	0
	1900	4	123	22.8	1012.5	0
10	100	3	200	22.3	1012.5	0
	700	4	193	23.4	1012.5	0
	1300	4	107	28.4	1012.1	0
	1900	4	171	25.7	1011.4	0
11	100	4	202	24.5	1011.8	0
	700	4	212	23.8	1013.1	0
	1300	4	123	30.1	1012.8	0
	1900	3	166	26.7	1012.8	0
12	100	4	198	24.7	1014.5	0
	700	5	210	25.1	1015.9	0
	1300	3	139	29.7	1015.9	0
	1900	3	143	25.1	1016.2	0
13	100	3	136	23.1	1017.2	0
	700	4	87	24.7	1017.2	0
	1300	4	64	27.8	1017.5	0
	1900	6	68	24.8	1015.9	0
14	100	6	89	24.3	1015.5	0
	700	5	160	24.2	1013.8	9
	1300	4	169	26.9	1012.1	0
	1900	5	186	25.5	1011.8	0
15	100	4	183	24.9	1012.5	0
	700	5	202	26.1	1013.5	7
	1300	3	154	27.5	1013.1	0
	1900	1	263	23.4	1013.5	0
16	100	4	128	23.8	1013.1	0
	700	3	158		1014.2	57
	1300	5	129		1013.1	0
	1900	2	222		1013.5	0

(Continued)

Table 2: Meteorological Data

Sep 1989							
		Wind Speed m/sec	Wind Direction deg TN	Temperature deg C	Atm Pressure mb	Precipitation mm	*
17	100	3	162		1012.5	0	
	700	3	223		1013.1	13	
	1300	0			1012.8	0	
	1900	5	4		1013.1	0	
18	100	5	34		1013.8	0	
	700	5	22		1014.5	0	
	1300	10	21		1015.2	0	
	1900	13	16		1014.2	0	
19	100	12	30		1012.1	0	
	700	6	87		1010.4	52	
	1300	9	73		1013.1	0	
	1900	9	70		1014.2	0	
20	100	9	75		1014.2	0	
	700	7	81		1015.9	15	
	1300	7	72		1016.5	0	
	1900	5	56		1017.5	0	
21	100	7	57		1017.2	0	
	700	7	37		1018.2	0	
	1300	8	46		1017.2	0	
	1900	11	49		1014.8	0	
22	100	12	68		1012.5	0	
	700	12	91		1011.8	6	
	1300	10	144		1009.8	0	
	1900	8	162		1008.7	0	
23	100	8	176		1009.4	0	
	700	5	165		1009.4	0	
	1300	5	185		1008.4	0	
	1900	8	232		1010.8	0	
24	100	16	340		1017.2	0	
	700	14	356		1020.9	9	
	1300	11	359		1023.0	0	
	1900	10	13		1023.6	0	
25	100	8	33		1023.0	0	
	700	11	29		1020.9	0	
	1300	9	31		1017.9	0	
	1900	13	47		1014.2	0	
26	100	5	154		1009.8	0	
	700	4	212		1009.4	52	
	1300	6	337		1010.4	0	
	1900	8	345		1013.8	0	
27	100	13	345		1017.2	0	
	700	14	352		1022.6	2	
	1300	12	359		1025.7	0	
	1900	10	12		1026.7	0	
28	100	9	23		1026.3	0	
	700	8	14		1027.0	0	
	1300	7	22		1025.3	0	
	1900	5	41		1023.3	0	
29	100	3	43		1020.9	0	
	700	0			1020.6	0	
	1300	2	228		1018.2	0	
	1900	2	148		1017.2	0	
30	100	3	209		1017.5	0	
	700	3	269		1018.6	0	
	1300	5	353		1019.6		
	1900	4	343		1019.2	0	
				Resultant 4	Mean 24.6	Mean 1015.9	Total 222

* Precipitation data for 15-30 September
taken from Supplemental Observations

PART III: WAVE DATA

Wave data are collected from two Baylor staff gages (Gages 625 and 645), a pressure wave gage (Gage 111) and a Waverider buoy (Gage 630) as shown in Table 1 and Figure 2. The data are collected, analyzed, and stored on magnetic tape using a Digital Equipment Corporation VAX 11/750 programmed to sample the wave gages every 6 hr (more frequently during storms) beginning at 0100, 0700, 1300, and 1900 EST. The sampling rate is two times per second for four contiguous 34-min records.

Wave height H_{mo} is an energy-based statistic equal to four times the standard deviation of the sea surface elevations. Wave height reported from the pressure gage has been compensated for hydrodynamic attenuation using linear wave theory. Wave period is identified from the computation of a variance (energy) spectrum with 60 deg of freedom calculated from a 34-min record. Peak wave period T_p is defined as the period associated with the maximum energy in the spectrum. When this analysis is complete, the data are written to magnetic tape.

Table 3 presents the wave heights and periods for each wave record obtained at 6 hr intervals during the month. The monthly means and standard deviations from the means shown in Table 3 are average values computed from this data. Figure 3 is a time history of all H_{mo} and T_p values obtained for all gages.

Differences in wave periods between wave gages (Table 3 and Figure 3) may be the result of wave breaking, wave reformation, or the presence of multiple wave trains containing nearly equal energy.

Table 3: Wave Data

Sep 1989

Day	Hour	645		625		111		630	
		Baylor at 7+80	Hmo,m	Baylor at 18+60	Hmo,m	Pressure Gage	T,sec	Offshr Wvrdr	Hmo,m
1	0100	0.40	5.12	0.53	10.67	0.50	11.13	0.60	11.13
	0700	0.43	5.82	0.57	10.67	0.60	10.24	0.66	5.57
	1300	0.35	4.74	0.54	9.85	0.53	9.48	0.58	10.67
	1900	0.31	11.13	0.50	10.67	0.51	10.67	0.61	10.67
2	0100	0.23	11.13	0.44	9.14	0.48	10.67	0.56	10.67
	0700	0.24	10.67	0.43	10.24	0.47	10.67	0.51	10.24
	1300	0.20	8.83	0.40	9.85	0.44	8.83	0.47	8.83
	1900	0.40	3.28	0.55	8.26	0.50	8.53	0.59	8.26
3	0100	0.52	3.41	0.68	3.51	0.58	3.51	0.73	3.46
	0700	1.18	5.57	1.37	5.33	1.44	5.12	1.68	5.33
	1300	1.03	5.82	1.16	5.57	1.24	5.57	1.44	5.57
	1900	1.54	6.09	1.78	6.24	1.91	6.09	2.01	6.09
4	0100	1.38	7.31	1.57	6.40	1.73	6.24	1.83	7.31
	0700	1.51	6.92	2.02	7.11	2.27	7.31	2.41	7.76
	1300	1.50	7.31	2.31	8.00	2.46	7.53	2.44	8.53
	1900	1.56	7.76	2.54	9.48	2.81	8.26	2.58	8.26
5	0100	1.57	8.83	2.28	7.76	2.39	9.48	2.33	7.31
	0700	1.43	6.09	2.05	8.00	2.24	8.00	2.19	8.53
	1300	1.32	6.56	1.83	9.48	1.92	8.83	1.79	9.85
	1900	1.34	8.83	1.72	17.07	1.86	17.07	1.90	17.07
6	0100	1.27	16.00	1.83	16.00	1.83	16.00	1.91	16.00
	0700	1.27	16.00	1.84	15.06	1.91	15.06	1.85	15.06
	1300	1.24	16.00	1.80	15.06	1.85	15.06	1.76	15.06
	1900	1.40	14.22	1.94	15.06	2.25	15.06	2.15	15.06
7	0100	1.49	14.22	2.09	14.22	2.29	15.06	2.24	14.22
	0700	1.52	14.22	2.32	14.22	2.41	14.22	2.38	14.22
	1300	1.63	15.06	2.17	15.06	2.35	15.06	2.44	14.22
	1900	1.44	13.47	1.91	12.19	2.06	14.22	2.11	15.06
8	0100	1.55	16.00	2.07	14.22	2.09	14.22	2.12	12.80
	0700	1.51	11.64	1.98	15.06	2.05	17.07	1.93	12.80
	1300	1.58	17.07	2.13	17.07	2.24	17.07	2.19	16.00
	1900	1.44	15.06	2.03	15.06	2.03	15.06	2.16	15.06
9	0100	1.01	12.80	1.50	13.47	1.64	12.80	1.62	12.80
	0700	1.23	13.47	1.73	13.47	1.81	12.80	1.65	13.47
	1300	1.68	14.22	2.36	13.47	2.41	14.22	2.29	13.47
	1900	1.53	15.06	2.04	14.22	2.17	14.22	1.86	15.06
10	0100	1.46	14.22	2.05	14.22	1.97	14.22	1.63	15.06
	0700	1.01	13.47	1.46	14.22	1.64	14.22	1.42	14.22
	1300	0.68	13.47	1.28	13.47	1.30	12.80	1.16	11.64
	1900	0.55	12.80	0.96	12.80	1.15	11.64	1.08	13.47
11	0100	0.52	12.80	0.92	12.19	1.00	12.19	0.95	10.67
	0700	0.38	11.64	0.74	10.67	0.81	11.64	0.81	11.64
	1300	0.40	12.80	0.70	12.80	0.74	11.64	0.79	11.13
	1900	0.34	12.19	0.70	11.64	0.73	11.64	0.70	11.13
12	0100	0.34	10.67	0.66	10.67	0.70	10.24	0.71	10.67
	0700	0.31	9.85	0.62	10.24	0.65	9.85	0.59	10.24
	1300	0.28	9.85	0.57	9.48	0.65	9.85	0.60	8.83
	1900	0.30	9.85	0.53	9.48	0.55	9.48	0.60	9.14
13	0100	0.31	11.13	0.56	8.26	0.58	7.76	0.57	9.14
	0700	0.31	8.26	0.50	8.83	0.55	9.85	0.55	8.53
	1300	0.39	2.81	0.57	8.83	0.54	8.53	0.60	8.53
	1900	0.46	4.13	0.62	8.00	0.55	8.53	0.71	7.53
14	0100	0.56	5.95	0.69	5.82	0.73	6.24	0.90	6.24
	0700	0.55	6.40	0.67	6.40	0.76	6.40	0.95	6.74
	1300	0.39	7.31	0.58	7.31	0.63	6.74	0.88	7.31
	1900	0.54	6.74	0.71	6.56	0.71	6.92	0.90	6.74
15	0100	0.39	7.31	0.55	6.92	0.62	6.92	0.73	7.11
	0700	0.37	5.45	0.49	6.74	0.52	7.11	0.61	7.11
	1300	0.26	6.24	0.43	6.92	0.52	6.92	0.54	6.74
	1900	0.37	6.40	0.49	7.31	0.52	6.74	0.64	5.95
16	0100	0.40	3.56	0.48	6.92	0.52	6.92	0.63	6.74
	0700	0.33	12.80	0.44	13.47	0.46	12.80	0.58	7.76
	1300	0.35	6.24	0.54	8.00	0.54	8.53	0.74	5.69
	1900	0.51	7.11	0.64	12.80	0.69	6.40	0.89	8.00

* Electronic problems

(Continued)

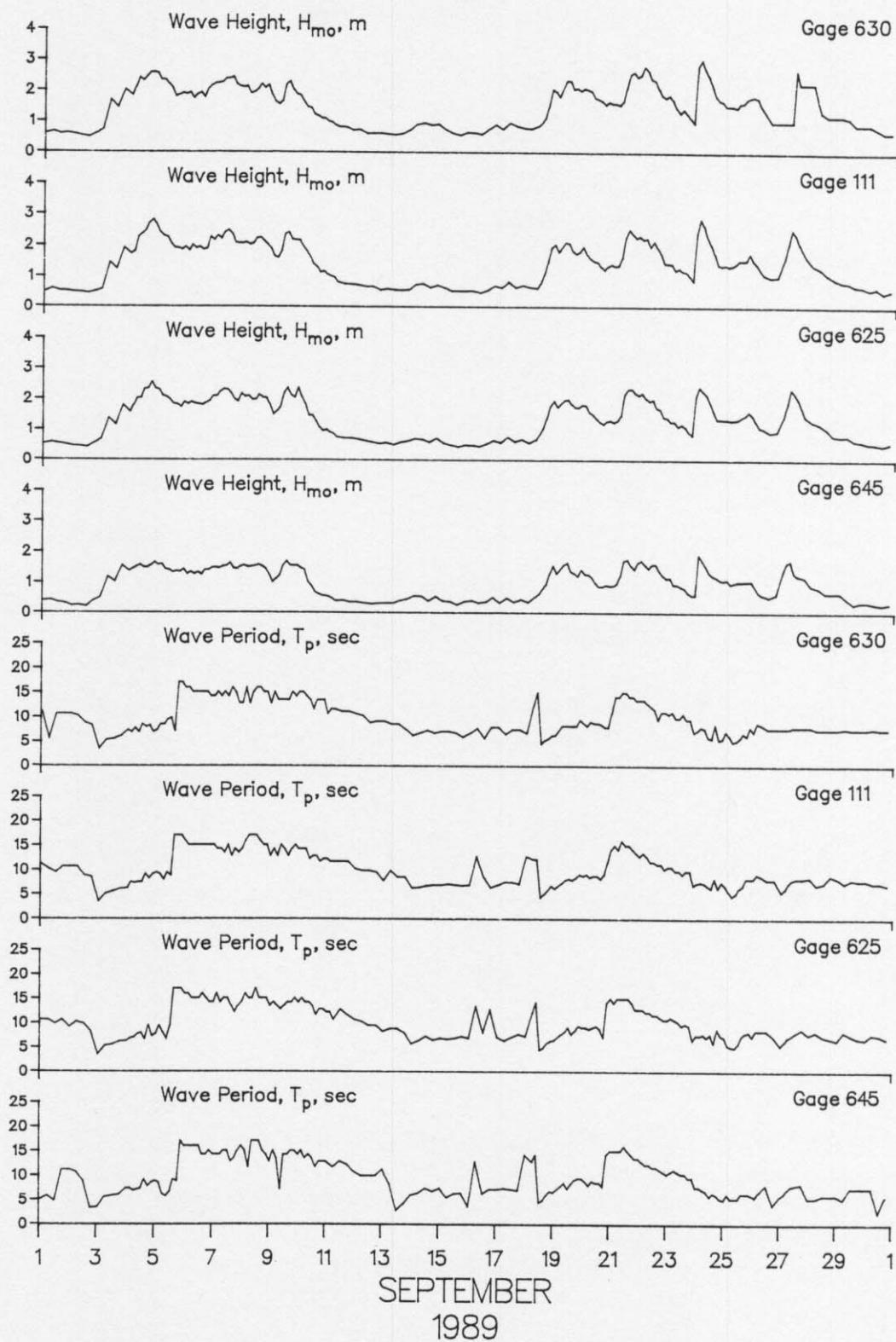
Table 3: Wave Data

Sep 1989

Day	Hour	645		625		111		630	
		Baylor at 7+80	Hmo,m T,sec	Baylor at 18+60	Hmo,m T,sec	Pressure Gage	T,sec	Offshrd Wvrdr	Hmo,m T,sec
17	0100	0.34	7.11	0.57	7.11	0.63	6.92	0.76	8.00
	0700	0.49	7.31	0.75	6.40	0.81	7.53	0.95	6.56
	1300	0.36	7.11	0.61	7.11	0.64	7.53	0.85	7.53
	1900	0.44	6.92	0.67	7.76	0.71	7.11	0.79	7.53
18	0100	0.35	14.22	0.56	7.31	0.64	12.80	0.77	6.74
	0700	0.54	12.80	0.68	12.19	0.61	12.19	0.86	12.80
	1300	0.79	4.41	1.08	4.49	1.08	4.34	1.13	4.57
	1900	1.31	5.95	1.80	5.95	1.94	5.82	2.04	5.69
19	0100	1.31	6.56	1.75	6.56	1.81	6.24	1.81	6.40
	0700	1.59	7.76	1.99	7.76	2.11	7.31	2.34	8.26
	1300	1.37	7.31	1.85	9.14	1.84	8.26	2.06	8.26
	1900	1.22	9.14	1.74	8.53	1.81	8.53	2.01	8.26
20	0100	1.29	9.48	1.81	9.14	1.73	8.83	2.04	8.83
	0700	1.17	8.00	1.52	8.83	1.51	8.53	1.78	9.14
	1300	0.88	8.53	1.27	9.48	1.32	8.83	1.67	8.83
	1900	0.93	7.76	1.29	7.11	1.34	9.14	1.64	8.00
21	0100	0.90	15.06	1.26	15.06	1.35	14.22	1.59	11.13
	0700	1.23	15.06	1.49	15.06	1.62	14.22	1.67	14.22
	1300	1.77	16.00	2.34	15.06	2.52	15.06	2.56	15.06
	1900	1.46	14.22	2.21	14.22	2.26	14.22	2.48	14.22
22	0100	1.73	13.47	2.20	12.80	2.21	12.80	2.80	13.47
	0700	1.48	12.19	1.96	12.19	1.97	12.80	2.40	12.80
	1300	1.61	11.64	1.72	11.64	1.94	11.64	2.08	11.64
	1900	1.23	11.13	1.43	11.13	1.44	11.13	1.79	11.13
23	0100	1.15	10.24	1.27	10.67	1.41	10.67	1.71	10.67
	0700	0.94	11.13	1.13	10.67	1.27	9.85	1.30	9.85
	1300	0.81	10.24	1.11	9.48	1.16	9.14	1.27	10.67
	1900	0.59	9.48	0.83	9.48	0.87	9.85	0.98	9.48
24	0100	1.91	7.53	2.41	7.53	2.85	7.31	3.03	7.31
	0700	1.54	7.11	2.15	7.76	2.26	7.31	2.50	7.76
	1300	1.22	5.69	1.59	7.76	1.74	6.24	1.85	5.69
	1900	1.09	5.95	1.35	8.83	1.35	6.24	1.66	5.45
25	0100	1.09	5.02	1.34	7.11	1.34	6.74	1.52	7.11
	0700	0.99	5.22	1.33	5.12	1.43	4.66	1.46	5.02
	1300	1.01	5.02	1.43	5.82	1.53	6.24	1.63	5.82
	1900	1.05	5.82	1.60	8.00	1.75	8.26	1.80	6.24
26	0100	0.79	5.45	1.29	7.31	1.41	8.26	1.78	7.11
	0700	0.59	6.56	1.05	8.53	1.07	8.83	1.34	8.53
	1300	0.51	8.00	0.92	8.53	0.98	8.00	0.99	7.76
	1900	0.61	3.94	0.96	7.31	1.00	8.00	*	
27	0100	1.39	5.69	1.46	5.45	1.62	5.45	*	
	0700	1.72	7.11	2.35	7.11	2.52	7.31	2.81	7.11
	1300	1.23	8.00	2.02	8.00	2.08	8.26	2.23	8.00
	1900	1.17	8.26	1.44	8.83	1.64	8.26	*	
28	0100	0.89	5.22	1.28	7.76	1.38	8.53	*	
	0700	0.82	5.22	1.20	8.26	1.27	6.92	1.33	7.53
	1300	0.66	5.82	1.05	7.31	1.07	7.31	1.20	7.53
	1900	*	*	0.81	6.92	0.93	8.83	*	
29	0100	*	*	0.77	6.56	0.84	8.26	*	
	0700	0.47	5.12	0.79	8.26	0.81	7.31	1.13	7.76
	1300	0.30	7.31	0.64	7.53	0.70	8.00	0.90	7.53
	1900	0.35	7.31	0.61	6.92	0.67	7.76	*	
30	0100	*	*	0.56	6.74	0.59	7.76	*	
	0700	0.30	7.31	0.54	7.76	0.63	7.31	0.79	7.76
	1300	0.26	2.37	0.49	7.53	0.49	7.31	0.65	7.53
	1900	0.31	5.57	0.56	6.92	0.56	6.92	*	
Mean		0.90	9.05	1.25	9.64	1.32	9.64	1.44	9.54
Std dev		0.49	3.68	0.63	3.13	0.67	3.16	0.68	3.15

* Electronic problems

(Sheet 2 of 2)



PART IV: CURRENT DATA

Current data (Table 4) are collected from a Marsh-McBirney electromagnetic biaxial current meter (Table 1 and Figure 2) and by visually observing the movement of dye on the water surface in the surf and at the seaward end of the pier, as well as 500 m updrift of the pier 12 m offshore.

Since the shoreline orientation is approximately N20W, longshore currents flow either toward 340 deg (i.e. northward) or toward 160 deg (i.e. southward). Similarly, cross-shore currents are either onshore (westward) or offshore (eastward).

All current speeds are given in centimeters per second (cm/sec). Resultant speeds and directions are determined by vector averaging the data.

Table 4: Current Data
Sep 1989

Day	Pier Measurements				Beach Measurements (500m Updrift)			Current Meter		
	Alongshore Cross-shore Resultant	Dye at (579 m) (surface)	Dye at Mid-Surf Zone (surface)	Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir
1 0100-Along Cross Result									14	S
1 0700-Along Cross Result	8 1 9	S off 151		0 0 0			7	S	20 12 18	off off 119
1 1300-Along Cross Result									11 7 13	S off 128
1 1900-Along Cross Result									7 3 8	N on 317
2 0100-Along Cross Result									8 6 10	N on 303
2 0700-Along Cross Result	25 4 26	S off 151		34 5 34	S on 169		14	S	20 2 20	N on 334
2 1300-Along Cross Result									3 8 9	N off 49
2 1900-Along Cross Result									5 3 6	N off 11
3 0100-Along Cross Result									3 8 9	S off 91
3 0700-Along Cross Result	51 10 52	N off 351		38 6 39	N on 331		27	N	6 4 7	N off 14
3 1300-Along Cross Result									28 20 34	S off 124
3 1900-Along Cross Result									41 22 47	S off 132
4 0100-Along Cross Result									38 22 44	S off 130
4 0700-Along Cross Result	23 23 32	S on 205		55 8 56	S on 169		50	S	25 17 30	S off 126
4 1300-Along Cross Result									37 25 45	S off 126
4 1900-Along Cross Result									41 27 49	S off 127
5 0100-Along Cross Result									31 23 39	S off 123
5 0700-Along Cross Result	61 0 61	S 0 160		12 4 12	S on 177		22	S	25 22 33	S off 119
5 1300-Along Cross Result									30 18 35	S off 129
5 1900-Along Cross Result									17 14 22	S off 121

KEY = All speeds in cm/sec

N = Northward, Shore parallel

S = Southward, Shore parallel

on = onshore off = offshore

Table 4: Current Data (Continued)
Sep 1989

Day	Alongshore Cross-shore Resultant Time	Pier Measurements				Beach Measurements (500m Updrift)			Current Meter			
		Dye at (579 m) (surface)	Dye at Mid-Surf Zone (surface)	Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir	Speed	Dir
6 0100-Along Cross Result									25	S		
6 0700-Along Cross Result	23 S 3 on 23 169			250	36 N 5 off 36 349			120 N South	32 13 35	S off 138		
6 1300-Along Cross Result									21 12 24	S off 130		
6 1900-Along Cross Result									31 27 41	S off 119		
7 0100-Along Cross Result									31 24 39	S off 122		
7 0700-Along Cross Result	12 S 3 off 12 146			274	102 N 0 on 102 340			83 N South	24 16 29	S off 126		
7 1300-Along Cross Result									13 15 20	S off 111		
7 1900-Along Cross Result									28 12 30	S off 137		
8 0100-Along Cross Result									17 8 19	S off 135		
8 0700-Along Cross Result	11 N 1 on 11 334			384	76 N 11 on 77 331			168 N South	21 11 24	S off 132		
8 1300-Along Cross Result									8 16 18	S off 97		
8 1900-Along Cross Result									22 11 25	S off 133		
9 0100-Along Cross Result									16 14 21	S off 119		
9 0700-Along Cross Result	0 3 off 3 70			445	0 2 off 2 70			26 N South	19 25 31	S off 107		
9 1300-Along Cross Result									8 21 22	N off 49		
9 1900-Along Cross Result									15 17 23	N off 29		
10 0100-Along Cross Result									7 10 12	N off 35		
10 0700-Along Cross Result	11 N 3 off 11 357			299	0 9 off 9 70			30 N South	1 3 3	S off 88		
10 1300-Along Cross Result									22 3 22	N on 332		
10 1900-Along Cross Result									13 3 13	N on 327		

KEY = All speeds in cm/sec

N = Northward, Shore parallel

S = Southward, Shore parallel

on = onshore off = offshore

Table 4: Current Data (Continued)
Sep 1989

Alongshore Cross-shore Resultant Time	Pier Measurements				Beach Measurements			Current Meter		
	Dye at (579 m) (surface)	Speed	Dir	Dye at Mid-Surf Zone (surface) Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir
Day										
11 0100-Along Cross Result									12	N
11 0700-Along Cross Result	5 4 6	N off 22		212	5 4 6	N off 22		South	5 3 3 4	N on off 25
11 1300-Along Cross Result									13 0 13	N 340
11 1900-Along Cross Result									16 4 16	N on 326
12 0100-Along Cross Result									10 0 10	N 340
12 0700-Along Cross Result	0 10 10			210	10 9 13	S off 118		South	16	N off 3 52
12 1300-Along Cross Result									11 1 11	N on 335
12 1900-Along Cross Result									9 3 9	N on 322
13 0100-Along Cross Result									4 0 4	S 160
13 0700-Along Cross Result	0 6 6			189	0 2 2			South	42	S off 14 16
13 1300-Along Cross Result									6 5 8	N off 20
13 1900-Along Cross Result									4 4 6	S off 115
14 0100-Along Cross Result									1 3 3	N off 52
14 0700-Along Cross Result	41 12 42	N off 357		152	20 8 22	N off 2		South	62	N off 7 12
14 1300-Along Cross Result									1 1 1	N on 295
14 1900-Along Cross Result									7 2 7	N on 324
15 0100-Along Cross Result									8 6 10	N on 303
15 0700-Along Cross Result	10 9 14	N off 22		165	10 6 11	N off 11		South	41	N on 8 10
15 1300-Along Cross Result									3 10	N 323
15 1900-Along Cross Result									8 5 9	N on 308

KEY = All speeds in cm/sec

N = Northward, Shore parallel

S = Southward, Shore parallel

on = onshore off = offshore

Table 4: Current Data (Continued)
Sep 1989

Day	Time	Pier Measurements				Beach Measurements			Current Meter		
		Alongshore Cross-shore Resultant	Dye at (579 m) (surface)	Dye at Mid-Surf Zone (surface)	Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir
16	0100-Along Cross Result									2	N
16	0700-Along Cross Result	10 10 14	N off 25		128	30 0 340	N		24 N	2 2 3	S off 115
16	1300-Along Cross Result									5 1 5	S off 149
16	1900-Along Cross Result									3 5 6	N on 281
17	0100-Along Cross Result									6 5 8	N off 20
17	0700-Along Cross Result	8 18 19	S off 94		140	12 1 12	N off 346		10 N	0 0 0	
17	1300-Along Cross Result									11 10 15	S off 118
17	1900-Along Cross Result									1 13 13	N off 66
18	0100-Along Cross Result									4 11 12	S off 90
18	0700-Along Cross Result	4 1 4	N on 323		147	7 2 7	N on 323		29 N	0 4 4	
18	1300-Along Cross Result									16 16 23	S off 115
18	1900-Along Cross Result									23 15 27	S off 127
19	0100-Along Cross Result									36 24 43	S off 126
19	0700-Along Cross Result	12 5 12	N on 318		207	102 10 102	N on 334		106 N	32 20 38	S off 128
19	1300-Along Cross Result									16 26 31	S off 102
19	1900-Along Cross Result									9 18 20	S off 97
20	0100-Along Cross Result									1 15 15	N off 66
20	0700-Along Cross Result	23 0 23	N 238 340		55	17 58	N on 323		102 N	0 2 2	
20	1300-Along Cross Result									0 6 6	
20	1900-Along Cross Result									6 2 6	N off 358

KEY = All speeds in cm/sec

N = Northward, Shore parallel

S = Southward, Shore parallel

on = onshore, off = offshore

Table 4: Current Data (Continued)
Sep 1989

Alongshore Cross-shore Resultant Time Day	Pier Measurements						Beach Measurements (500m Updrift)			Current Meter	
	Dye at (579 m) (surface)	Speed	Dir	Dye at Mid-Surf Zone (surface)	Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir
21 0100-Along Cross Result										4	N
										3	off
										5	17
21 0700-Along Cross Result	10	N		61	N			56	N	15	N
	2	on		6	off					1	off
	10	331		61	346					15	344
21 1300-Along Cross Result										23	N
										7	off
										24	357
21 1900-Along Cross Result										25	N
										3	off
										25	347
22 0100-Along Cross Result										27	N
										3	on
										27	334
22 0700-Along Cross Result	68	N		122	N			173	N	29	N
	7	on		0						7	on
	68	334		122	340					30	326
22 1300-Along Cross Result										44	N
										14	on
										46	322
22 1900-Along Cross Result										22	N
										14	on
										26	308
23 0100-Along Cross Result										24	N
										13	on
										27	312
23 0700-Along Cross Result	38	N		68	N			43	N	19	N
	10	off		17	off					10	on
	39	354		70	354					21	312
23 1300-Along Cross Result										25	N
										13	on
										28	313
23 1900-Along Cross Result										14	N
										10	on
										17	304
24 0100-Along Cross Result										56	S
										31	off
										64	131
24 0700-Along Cross Result	51	S		76	S			37	S	46	S
	0			0						26	off
	51	160		76	160					53	131
24 1300-Along Cross Result										29	S
										18	off
										34	128
24 1900-Along Cross Result										28	S
										17	off
										33	129
25 0100-Along Cross Result										16	S
										12	off
										20	123
25 0700-Along Cross Result	9	S		25	S			13	S	21	S
	2	off		0						16	off
	9	149		25	160					26	123
25 1300-Along Cross Result										27	S
										23	off
										35	120
25 1900-Along Cross Result										26	S
										19	off
										32	124

KEY = All speeds in cm/sec

N = Northward, Shore parallel

S = Southward, Shore parallel

on = onshore off = offshore

Table 4: Current Data (Concluded)
Sep 1989

Day	Time	Pier Measurements				Beach Measurements			Current Meter	
		Alongshore Cross-shore Resultant Dye at (579 m) (surface)	Speed	Dir	Dye at Mid-Surf Zone (surface) Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface) Location	Speed	Dir
26	0100-Along Cross Result								21	S
26	0700-Along Cross Result	8 8 12	S off 115		146	68 17 70	N off 354	7 N South	18 11 21	S off 137 129
26	1300-Along Cross Result								22 26 34	S off 110
26	1900-Along Cross Result								25 23 34	S off 117
27	0100-Along Cross Result								37 20 42	S off 132
27	0700-Along Cross Result	23 0 23	S off 160		226	68 0 68	S off 160	23 S South	41 25 48	S off 129
27	1300-Along Cross Result								31 20 37	S off 127
27	1900-Along Cross Result								29 17 34	S off 130
28	0100-Along Cross Result								15 12 19	S off 121
28	0700-Along Cross Result	27 9 28	S off 141		152	8 9 13	S off 112	11 S North	17 13 21	S off 123
28	1300-Along Cross Result								11 10 15	S off 118
28	1900-Along Cross Result								12 5 13	S off 137
29	0100-Along Cross Result								6 6 8	S off 115
29	0700-Along Cross Result	6 2 7	S off 141		128	17 3 17	N on 331	9 S North	7 4 8	S off 130
29	1300-Along Cross Result								3 3 4	N off 25
29	1900-Along Cross Result								10 2 10	N on 329
30	0100-Along Cross Result								11 2 11	N on 330
30	0700-Along Cross Result	15 2 15	N on 334		128	23 5 24	N on 329	10 N South	8 1 8	N on 333
30	1300-Along Cross Result								3 9 9	S off 88
30	1900-Along Cross Result								9 8 12	S off 118

KEY = All speeds in cm/sec

N = Northward, Shore parallel

S = Southward, Shore parallel

on = onshore off = offshore

PART V: SUPPLEMENTAL OBSERVATIONS

Visual wave direction measurements (Table 5) of both the primary wave train (i.e. that having the larger wave heights) and the secondary wave train (which must be clearly distinguishable as a wave train separate from the primary waves but not surface chop or capillary waves) are taken daily at the seaward end of the pier. The direction of the primary wave train just north of the seaward end of the pier is also determined using a Raytheon Marine Pathfinder radar and measuring the alignment of the wave crests at approximately the same location as the visual measurements. The pier axis (considered perpendicular to the beach at the FRF) is orientated 70 deg east of true north; consequently, wave angles greater than 70 deg indicate that the waves were coming from the south side of the pier.

The width of the surf zone (seawardmost breaker position to shoreline) is determined from the pier deck.

Measurements of surface water temperature, density, and visibility are also taken daily at the seaward end of the pier. A jar along with a thermometer is lowered about 0.3 m into the water and allowed to remain for at least one minute. The jar is removed, the temperature read, and a hydrometer is used to determine the density. A Secchi disc is used to determine the surface visibility.

Table 5: Supplemental Observations

Sep 1989

Day	Time	Wave Approach Angle at Pier End		Radar Wave Angle deg from True N	Width of Surf Zone, m	Water Characteristics at Pier End		
		Primary	Secondary			Temp., C	Density g/cc	Secchi Vis., m
1	0640	50	80		15	26.7	1.0172	3.7
2	0735	50		55	30	26.7	1.0224	1.8
3	0853	90			9	25.5	1.0220	2.7
4	0655	55		60	210	25.8	1.0192	1.5
5	0740	70	45	70	219	25.7	1.0192	0.9
6	0926	95		95	180	25.6	1.0192	0.6
7	0700	95	60	90	317	25.4	1.0190	0.6
8	0700	95	50	95	397	22.8	1.0194	0.6
9	0800	90		80	317	24.0	1.0194	0.6
10	0900	85		75	239	24.6	1.0192	0.9
11	0730	80	50		87	24.5	1.0212	1.5
12	0700	80	60	70	12	24.4	1.0224	1.2
13	0730	55		75	45	25.0	1.0222	1.2
14	0645	100		70	69	25.0	1.0224	1.5
15	0730	120		65	10	23.9	1.0225	1.5
16	0830	85	115		12	25.6	1.0224	1.5
17	0750	80	130		6	25.6	1.0226	1.5
18	0645	95		75	19	23.8	1.0223	4.0
19	0700	90	25	105	280	24.4	1.0219	0.6
20	0645	105		85	266	24.5	1.0204	0.9
21	0700	105		90	287	24.7	1.0211	1.2
22	0940	100		100	317	25.5	1.0212	0.3
23	0800	90		85	192	25.8	1.0222	0.6
24	0730	55		50	354	23.9	1.0226	0.6
25	0653	90	55	100	88	22.2	1.0220	0.6
26	0650	80	110	inoperative	91	23.4	1.0204	0.9
27	0938	50		inoperative	354	21.7	1.0200	0.6
28	0917	55		60	82	21.1	1.0194	0.9
29	0750	85			37	21.7	1.0194	0.9
30	0730	90	10		27	22.2	1.0200	1.2

PART VI: WATER LEVELS

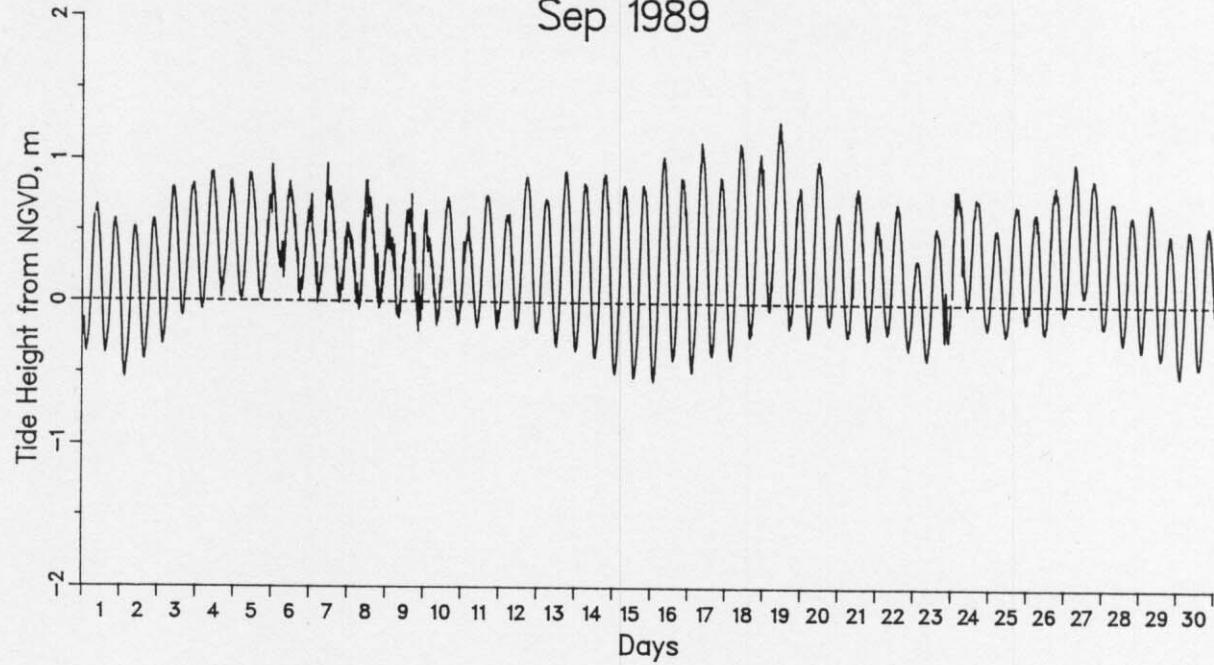
Since 1978, the National Oceanic and Atmospheric Administration (NOAA)/National Ocean Service (NOS) has operated a primary tide station (No. 865-1370) at the seaward end of the FRF pier. A Leupold-Stevens digital recording float-type tide gage is used to collect instantaneous water level data every 6 minutes throughout the month.

The variation in water level during the month is shown in Figure 4 along with a list of mean and extreme values. This presentation is useful in identifying effects of both meteorological and astronomical forces on the open coast water level.

Table 6 contains the time at the center of each 12.42-hr tidal cycle and the range, high, low, and mean water levels during each tidal cycle.

FRF Tide Heights

Sep 1989



Monthly Water Levels, m NGVD

Extreme Low = -0.55 on day 16 at 106 EST
Extreme High = 1.28 on day 19 at 954 EST
Monthly Mean = 0.28
Mean Low = -0.23
Mean High = 0.78
Mean Range = 1.00

Table 6: Water Levels, m NGVD

		Sep 1989			
Day	Mid-Cycle Time	Low	High	Mean	Range
1	612	-0.36	0.68	0.15	1.04
1	1837	-0.37	0.58	0.09	0.94
2	703	-0.53	0.52	0.02	1.05
2	1928	-0.41	0.57	0.09	0.98
3	753	-0.30	0.80	0.28	1.11
3	2018	-0.10	0.83	0.38	0.93
4	843	-0.05	0.91	0.45	0.96
4	2109	0.02	0.85	0.43	0.83
5	934	0.02	0.90	0.45	0.88
5	2159	0.01	0.96	0.44	0.95
6	1024	0.06	0.84	0.49	0.78
6	2249	-0.01	0.75	0.34	0.76
7	1115	0.03	0.97	0.45	0.94
7	2340	-0.02	0.55	0.25	0.57
8	1205	-0.05	0.85	0.42	0.91
9	30	-0.09	0.68	0.24	0.77
9	1255	-0.11	0.76	0.31	0.87
10	121	-0.20	0.65	0.21	0.85
10	1346	-0.16	0.74	0.32	0.90
11	211	-0.16	0.60	0.18	0.77
11	1436	-0.18	0.75	0.32	0.93
12	301	-0.18	0.62	0.23	0.80
12	1527	-0.18	0.88	0.37	1.06
13	352	-0.21	0.73	0.26	0.94
13	1617	-0.30	0.92	0.31	1.23
14	442	-0.34	0.84	0.25	1.18
14	1707	-0.38	0.91	0.25	1.29
15	532	-0.50	0.83	0.18	1.33
15	1758	-0.52	0.83	0.16	1.35
16	623	-0.55	1.03	0.28	1.58
16	1848	-0.42	0.88	0.23	1.30
17	713	-0.48	1.13	0.36	1.62
17	1938	-0.37	0.89	0.25	1.26
18	804	-0.39	1.13	0.40	1.52
18	2029	-0.23	1.06	0.40	1.29
19	854	-0.05	1.28	0.62	1.33
19	2119	-0.17	0.83	0.30	1.00
20	944	-0.24	1.01	0.42	1.25
20	2210	-0.15	0.65	0.22	0.80
21	1035	-0.23	0.82	0.30	1.05
21	2300	-0.25	0.59	0.18	0.84
22	1125	-0.21	0.71	0.26	0.92
22	2350	-0.32	0.31	0.00	0.63
23	1216	-0.39	0.54	0.10	0.93
24	41	-0.26	0.81	0.31	1.07
24	1306	-0.03	0.75	0.39	0.78
25	131	-0.17	0.54	0.18	0.71
25	1356	-0.22	0.71	0.26	0.92
26	222	-0.12	0.65	0.25	0.78
26	1447	-0.20	0.84	0.34	1.04
27	312	-0.07	1.01	0.47	1.08
27	1537	0.06	0.89	0.46	0.83
28	402	-0.15	0.73	0.29	0.89
28	1628	-0.27	0.64	0.18	0.91
29	453	-0.32	0.73	0.21	1.05
29	1718	-0.37	0.51	0.05	0.88
30	543	-0.50	0.54	0.03	1.04
30	1808	-0.44	0.57	0.08	1.00

PART VII: NEARSHORE PROFILES

A. Nearshore Profiles. In order to document profile response away from the pier, surveys of four profile lines extending 900 to 1,000 m from shore and located 489 and 581 m north and 517 and 608 m south of the FRF pier are conducted bi-weekly, after storms, and during more complete bathymetric surveys.

These profiles are obtained using the CRAB-Zeiss surveying system; a Zeiss Elta-2 first-order, self-recording electronic theodolite distance meter in combination with the Coastal Research Amphibious Buggy (CRAB), a 10.7 m high, self-powered, mobile tripod on wheels.

Figure 5 shows the last survey in August and the only survey in September on profile line 188, located 517 m south of the pier. The September survey followed several days of long period (12-17) sec) swell generated by Hurricane Gabrielle and thus represents the changes induced by these waves. On the foreshore (80 - 160 m), the removal of the berm resulted in a narrow, steeper beach. A large prominent nearshore bar (120 - 260 m) was also built while only minor changes are visible offshore.

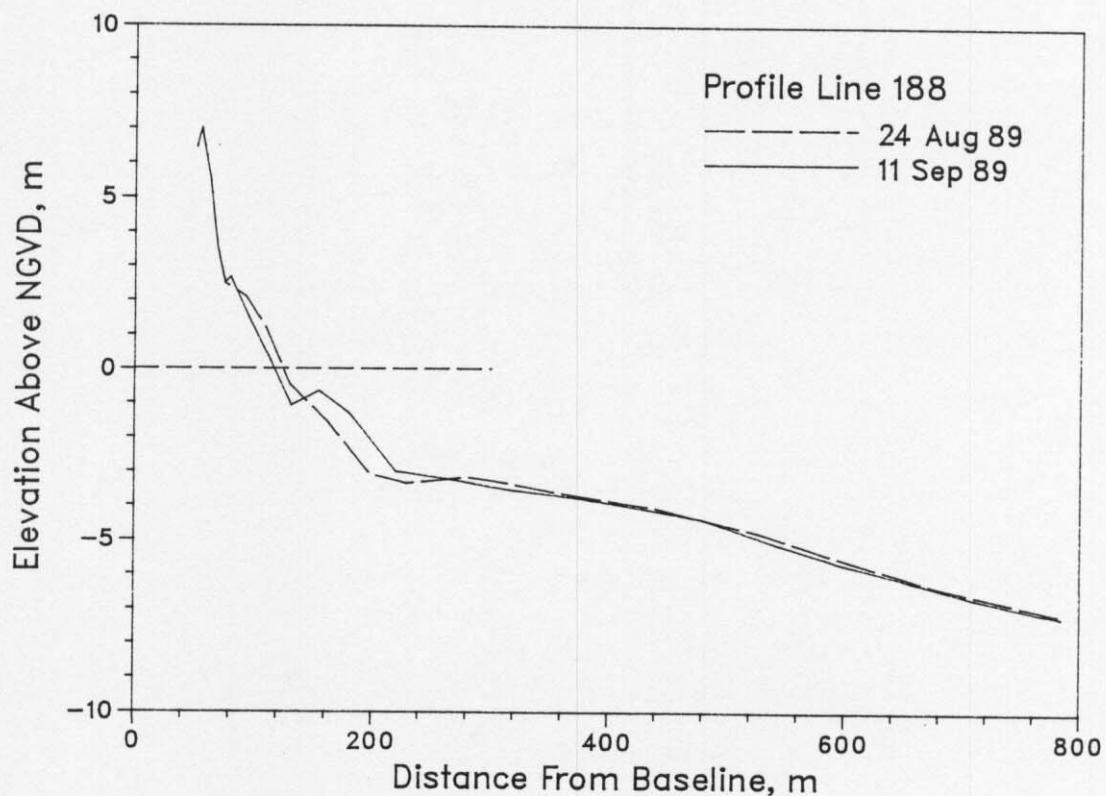


Figure 5. Monthly CRAB profiles on profile 188 - 517 m south of pier.

The profile envelope (Figure 6) reflects the maximum changes that occurred on the profile during 1988. Both changes (120 - 160 m) are a result of the creation of the nearshore bar.

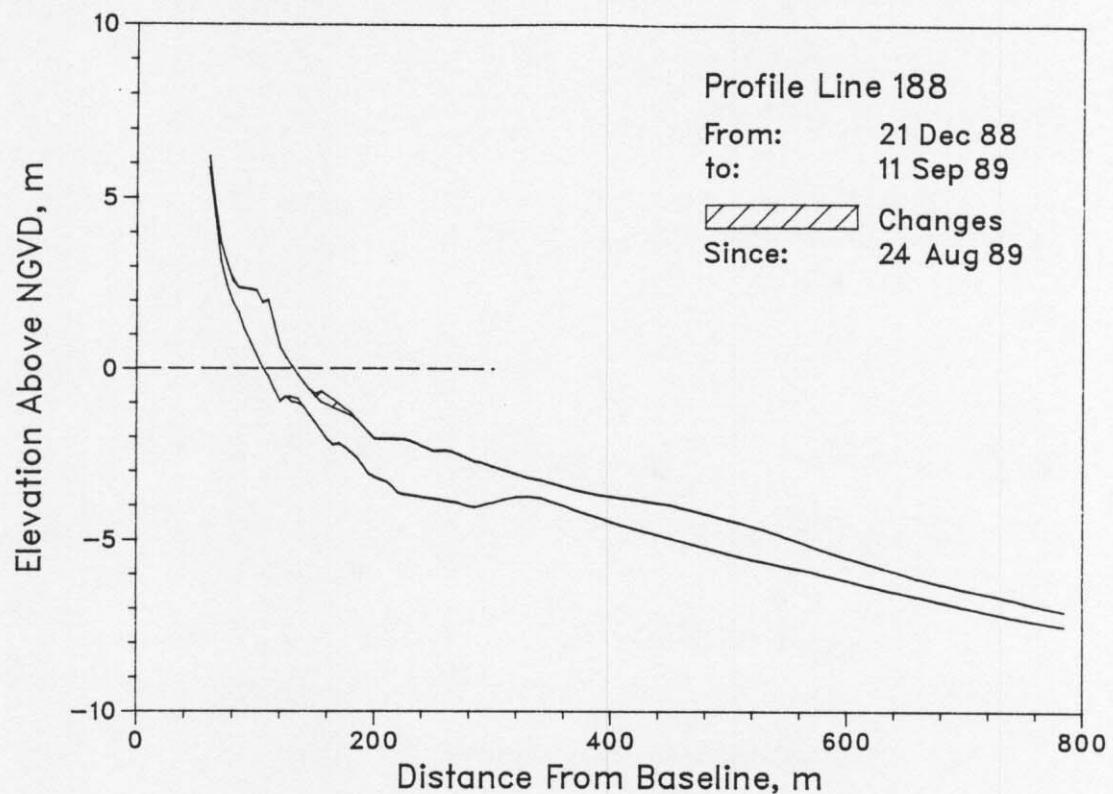


Figure 6. CRAB profile envelope - profile 188.

B. Bathymetry. Figure 7 includes a two- and three-dimensional contour map and a change plot derived from the bathymetric survey on 12 September. Wide contour lines on the change diagram represent eroded areas; thin lines indicate deposition.

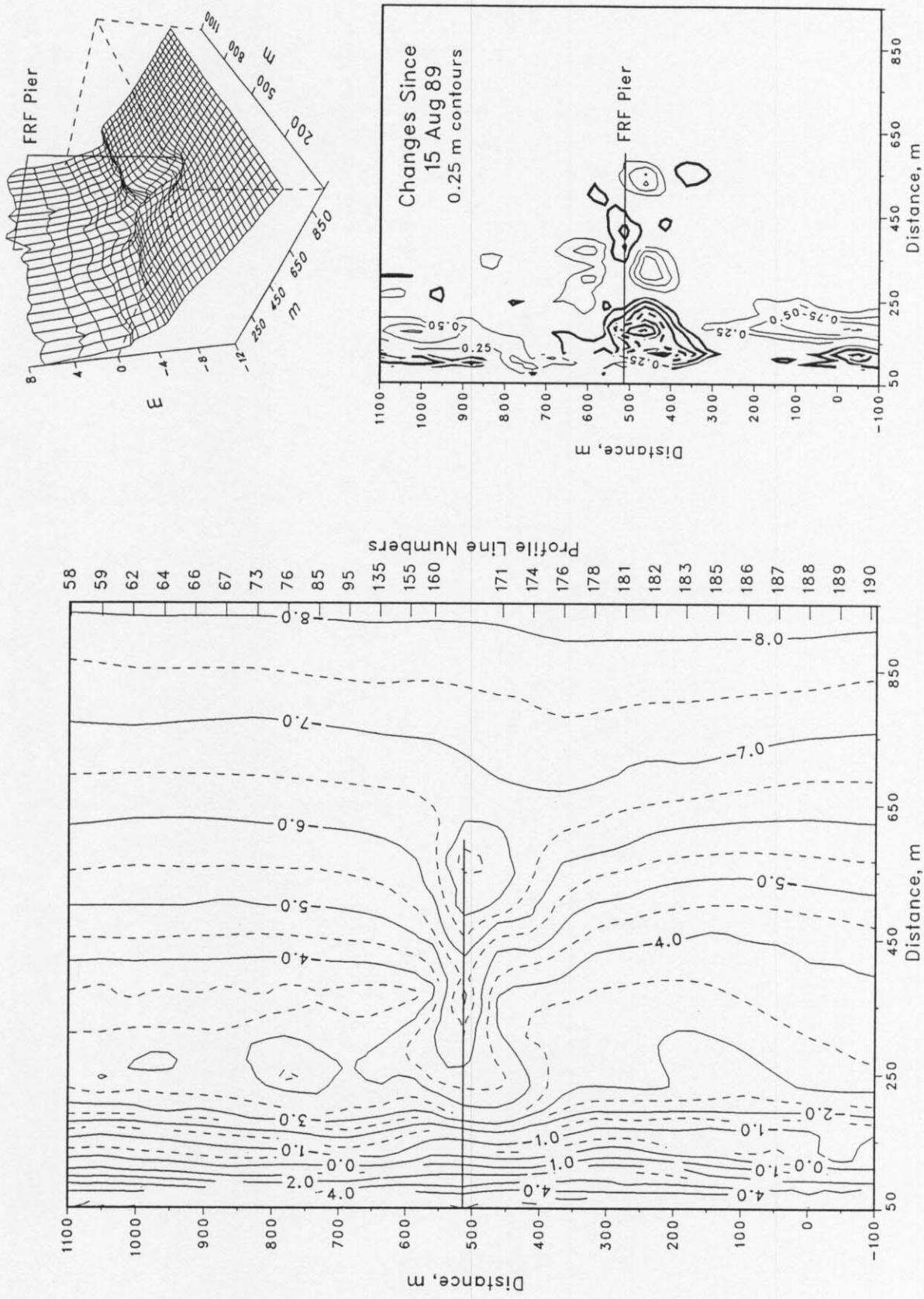


Figure 7. FRF bathymetry 12 Sep 89 depths relative to NGVD

PART VIII. SPECIAL EVENTS

A. Storm Data Collection. The following list identifies times when the significant wave height at the seaward end of the pier (i.e. as measured at the end of the pier) exceeded 2 m and four contiguous 34 minute wave records were obtained every three hours:

<u>Start</u>	<u>End</u>
4 Sep (0700)	10 Sep (0208)
21 Sep (1000)	22 Sep (0542)
23 Sep (2200)	24 Sep (0842)
27 Sep (0434)	27 Sep (1300)

B. Storm Synopsis.

4-10 September (Hurricane Gabrielle) - Storm waves, initially caused by strong (over 13 m/s) northeast winds following the passage of a cold front on 3 September, attained an H_{mo} (at gage 625) of 2.54 m ($T_p = 9.48$ sec) late on 4 September. Moderate onshore winds through 5 September kept the H_{mo} above 2 meters. Early on 6 September, with the H_{mo} hovering just above 2 meters, the period took a dramatic jump to over 15 seconds. This swell was generated by Hurricane Gabrielle, which remained well out to sea as it skirted the Bahamas on a northerly track which paralleled the U.S. coast. These long period waves continued to buffet the Outer Banks through the morning of 10 September. The highest measured H_{mo} (at gage 625) of 2.54 m ($T_p = 13.47$ sec) was recorded at 1108 EST on 9 September. Because the hurricane remained far offshore, neither the atmospheric pressure nor the winds at the FRF were influenced by the storm.

21-22 September (Hurricane Hugo) - Hurricane Hugo made landfall at approximately 2200 hours on 21 September near the city of Charleston, SC, causing tremendous damage to the beaches and coastal towns of South Carolina. Other communities far from the coast were also damaged as the storm travelled well inland before turning to the north. The FRF, which is approximately 565 kilometers (350 miles) north of Charleston, received only minimal effects from Hugo as the storm's inland path was well west of the area. Waves with H_{mo} exceeding 2 m began arriving at the FRF early on 21 September with the highest H_{mo} (at gage 625) of 2.50 m ($T_p = 15.06$ sec) recorded several hours later at 1408 EST. Maximum onshore (from the northeast) winds exceeded 12 m/s late on 21 September. Due to the storm's distance, the atmospheric pressure only dropped to 1011.4 mb early on 22 September. There was no precipitation at the FRF.

23-24 September - Following the passage of a cold front, strong winds generated by a large high pressure system located over Michigan began to

affect the FRF late on 23 September. Maximum wind speeds (from the north, northeast) exceeding 18 m/s occurred on 23 September at 2200 EST. The maximum H_{mo} (at gage 625) of 2.50 m ($T_p = 7.53$ sec) was recorded two hours later at 2342 EST. Precipitation totaled 6 mm.

27 September - Forming off the Georgia coast early on 25 September, this "northeaster" quickly moved up the coast reaching the Maryland shore on 26 September. Peak winds (from the north) exceeded 15 m/s on 27 September at 0434 EST. The maximum H_{mo} (at gage 625) of 2.39 m ($T_p = 7.76$ sec) occurred four hours later at 0842 EST. The minimum atmospheric pressure of 1008.6 mb was recorded on 26 September at 0400 EST. Precipitation totaled 54 mm.

Distribution List

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OCE	U.S. Geological Survey
BERH	U.S. National Park Service
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